Title: Method and device for collecting animals in or on a water bottom.

The invention relates to a method for collecting animals living in or on a water bottom. In particular, the invention relates to a method for collecting crustaceans and shellfish and/or fish living in or on a sea bottom.

As a rule, crustaceans and shellfish living on or in the sea bottom are fished with the aid of trawls which are dragged along the sea bottom. Such trawls are provided with knives reaching into the bottom such that the knives are pulled through the sea bottom with a cutting edge forward. A jet of water is directed at an obtuse angle, in particular approximately at right angles to the direction of movement, approximately vertically to the sea bottom, under high pressure, directly in front of the knives so that the soil of the sea bottom is stirred up and raised. As a result, the crustaceans and shellfish, such as cockles, are disengaged and can move over and/or along the knives. Behind the knives, in the trawl, a collecting basket is arranged in which the crustaceans and shellfish are caught while mud, sand, sediment, undersized shellfish and the like can flow back through the basket. The animals are discharged via a tube system to the craft trawling the trawl.

When using this known method, the sea bottom is agitated in a number of ways which may lead to damage to the environment. For instance, as a result of the water injection and, in particular, the pressure and direction of the jet of water, a relatively large mass of sediment is flushed from the bottom and brought into the water. Moreover, relatively deep, long furrows are made by the knives in the sea bottom. The trawl is heavy so as not to lose contact with the sea bottom. The fact is that as a result of, on the one hand, the trawling force applied to the trawl by the craft and, on the other hand, the force of the jet of water directed approximately vertically, during use, a buoyant force is applied to the trawl which must be compensated by the self-weight of the trawl. This relatively heavy weight of the trawl is borne by runners with which the trawl rests on the sea bottom. These runners cause a

further disturbance of the sea bottom, at least of the sediment, growth, marine animals *et cetera*. When using the trawl on a relatively weak bottom, furrows which are drawn by the trawl in the bottom will be relatively deep, so that the bottom disturbance will be further enhanced.

The invention contemplates a method for collecting animals living in or on a water bottom, wherein the above-mentioned drawbacks have been avoided, at least partly, while maintaining the advantages of the known method. To that end, the method according to the invention is characterized by the features of claim 1.

With a method according to the invention, water or a different fluid such as, for instance, gas, compressed or not compressed or slurry is introduced into the bottom under pressure, directly above, below or in front of a or each tine, only at that location where the soil is to be loosened somewhat. The bottom is stirred up no more than necessary for disengaging the animals. Preferably, the fluid is introduced into the water bottom at a very small angle, or, more in particular, approximately parallel to the bottom surface, for instance only a few centimeters below the bottom surface, so that the water bottom is only minimally agitated.

As a consequence of this method, the advantage is achieved that through the jet or jets the device will experience virtually no forces directed away from the sea bottom and therefore will no longer be pushed upwards, so that this device can be of a lighter design and hence will lead to less disturbance of the sea bottom. Moreover, less fluid, in particular water, is to be introduced into the soil, so that less energy is required and the disturbance is even more reduced. As a result of the relatively light weight, moreover, the power required for advancing the device is reduced so that environmental advantages are achieved, while, furthermore, less turbulence occurs in the water as a result of the craft's drive.

With a method according to the invention, further, the advantage is achieved that the chance of animals escaping underneath the tines is

considerably reduced. The fact is that the extent to which the bottom, for instance, the sediment, is agitated is relatively small. Only the part in which the shellfish or on which the fish are present, is agitated and loosened. Therefore, the animals can practically not move downwards or be moved downwards.

In this application, tine is at least understood to mean a portion of the trawl or a part attached thereto such as a part which is usually indicated as a knife. With a device and method according to the invention a fluid can be supplied through or along the tines and be squeezed or blown out, to which end separate outflow means can be provided.

As a result of the relatively local and particularly limited disturbance of the water bottom, the animals, in particular the fish, will behave more calmly. Thus, the additional advantage can be achieved that the animals will experience less stress and will become less contaminated, i.e. will take up less sand, particularly the crustaceans and shellfish, so that the quality of the animals collected is even more increased.

In further elaboration, a method according to the invention is preferably characterized by the features of claim(s) 4 and/or 5.

With such a method, with the aid of detection means, the presence of animals in or on the bottom is detected, on the basis of which means for moving the animals from or off the bottom can be selectively controlled. This means that the disturbance of the sea bottom can be reduced even further. The fact is that through this method, it can be ensured that the sea bottom is only disturbed by the means for moving the animals from of off the sea bottom when such an animal has been detected by the detecting means. There where no animals are detected, at least too small a density of animals, the respective means will be brought or kept in a position of rest so that no, at least minimal disturbance of the bottom occurs. An additional advantage is that the energy required for collecting is further reduced. The fact is that when no animals are

detected, for instance, no tines will reach into the bottom and effect resistance and no electrical means will have to be controlled for startling the animals.

For locally and purposely startling the animals such as fish, naturally, different means can also be utilized, for instance mechanical means such as chains which can be specifically controlled on the basis of a signal coming from a detection means, sound or other vibration sources, air or other fluid sources, specifically controllable and the like.

In a further elaboration, a method according to the invention is preferably characterized by the features of claim 6.

By using sound ranging, in particular ultrasonic sound ranging, the advantage is achieved that in a particularly simple and accurate manner animals can be detected and distinguished from the bottom as such and other objects present in or on the bottom, growths and the like.

Naturally, also different detecting means can be used, for instance feelers which can recognize the bottom structure or elevations on the bottom, image recognition means such as cameras and the like, heat sensors and the like. With these, for instance humps, raised by animals living in the bottom, can be detected and recognized on the basis of which the collecting means such as tines or startling means can be controlled or populations be determined.

The animals disengaged from the bottom with the aid of the device can be collected in a simple manner, by using, for instance, collecting baskets known per se and discharge means, trawling nets and the like.

The invention further relates to a device for collecting animals living on or in a water bottom, characterized by the features of claim 9.

Through the use of the respective detecting means, collection can take place accurately there where the animals are present, at least in a desired concentration, while at other positions, for instance there where no or only little animals are present, the sea bottom can at least virtually be left undisturbed. As a result, damage to the environment is reduced to a minimum,

the desired animals can be collected rapidly and easily. The device can be of relatively light design.

In an advantageous embodiment, a device according to the invention is characterized by the features of claim 10.

In such an embodiment, water or a different fluid such as gas or slurry can be introduced into the bottom through or along at least one tine, preferably at a slight angle or approximately parallel to the bottom surface directly at the location of the respective tine, such that water under pressure can be inserted into the bottom relatively flat and agitates only a top layer of the bottom. The fluid supply means can for instance be designed such and set such that only a few centimeters of the water bottom are stirred up. As a result hereof, animals present directly below this surface such as crustaceans and shellfish, for instance cockles, can simply be taken from the water bottom by the or each tine, and be discharged.

It is preferred that a row of tines is provided, which row preferably extends approximately transversely to the direction of movement of the device.

In a preferred embodiment, a device according to the invention is characterized by the features of claim 12.

With such an embodiment, during use, one or more tines can be moved into and out of the water bottom, in particular a sea bottom, depending of the presence or absence of animals to be taken up, at least in a desired concentration.

In a further alternative embodiment, a device according to the invention is further characterized by the features of claim 14.

In such an embodiment, animals such as fish living on the bottom, for instance flatfish, can simply be startled such that these animals are disengaged from the bottom with minimal stress and can be caught in a net. Preferably, a series of electric means is provided, as well as a series of detecting means, such that over a relatively large width animals can be detected at different positions in front of the device and depending thereon can

be startled. Naturally, also different means can be used for startling the animals, for instance mechanical and/or acoustic and/or fluid blowing or spouting means, controllable on the basis of detection signals, as described hereinabove with reference to a method according to the invention.

The invention further relates to a device according to the invention, combined with a craft, wherein between the craft and the device a flexible hose or tube is provided through which water can be supplied to the device and/or the animals can be moved from the device to the craft. Use of such a flexible hose or tube offers the advantage over the use of customary rigid tubes that with it, virtually no forces, at least no buoyant forces are applied to the device, so that the craft is prevented even better from coming free from the bottom, for instance upon changes of speed, changes of depth and the like.

In the further subclaims, other advantageous embodiments of a method and device of the invention are represented.

In clarification of the invention, exemplary embodiments of a method and device according to the invention will be further elucidated with reference to the drawing. In the drawing:

Fig. 1 schematically shows a craft with a device according to the invention, during use;

Fig. 2 schematically shows, in side view, a device according to the invention, during use;

Fig. 3 schematically shows, in top plan view, a device according to the invention with a series of tines and a series of detecting means;

Fig. 4 schematically shows, in top plan view, a device according to the invention with a series of detecting means with associated electric means and a net;

Fig. 5 schematically shows an alternative device for a tine; and

Fig. 6 schematically shows a part of an alternative embodiment of a device according to the invention with suction means for taking up animals.

In this description, identical or corresponding parts have identical or corresponding reference numerals. In this description, the starting point will be devices and methods for collecting crustaceans and shellfish, such as cockles (see, for instance, Figs. 2 and 3) living in a sea bottom, and devices and methods for collecting fish, such as flatfish (see for instance Fig. 4), living on or in the bottom. In this description, the terms bottom, water bottom and sea bottom are used indiscriminately and are all used to indicate a bottom of a water mass, fresh, brackish or salt, in which fish and/or shellfish and/or crustaceans can be collected. Where, in this text, the term fluid is used, at least also water, gas such as air, slurry and such fluids are understood to be included. As an example, water is used but it can be substituted with any fluid unless expressly indicated differently.

The exemplary embodiments shown in the drawing are only shown by way of example. Combinations of parts of the exemplary embodiments shown are possible within the framework of the invention.

In Fig. 1, schematically in side view, a water mass 1 such as a sea is shown with a water bottom 2, further also indicated as bottom or sea bottom 2. In the water mass 1, a craft 3 is shown, which, via a hauling cable 4, for instance a steel cable, chain or synthetic cable, is connected to a collecting device 5, further also called trawl, which can be dragged along the water bottom 2 via the cable 4. The collecting device 5 is provided with supporting means 6, for instance runners with which the trawl 5 rests on the water bottom 2. In the exemplary embodiments shown in Figs. 3 and 4, two runners 6 are shown, placed at a mutual distance from each other, for reasons to be mentioned hereinafter. In Fig. 1, the trawl 5 is schematically shown as a rectangle. In Figs. 2 – 4, embodiments thereof are shown. Further, between the craft 3 and the collecting device 5, a flexible hose or tube 7 is shown through which water can be supplied under pressure to the collecting device 5, and/or animals collected by the device 5 can be discharged to the craft 3. The hose 7 can for instance be designed to be double-walled, for, on the one hand,

supplying fluid and, on the other hand, discharging animals. Optionally, two hoses 7A, 7B can be provided, as shown, for example, in Fig. 2. With such an embodiment, water can be supplied through the first hose or tube 7A, for reasons to be mentioned hereinafter, while through the second tube or hose 7B animals can be discharged. Using one or more flexible tubes or hoses 7 can prevent the trawl 5 from thus being pulled from the water bottom 2. The fact is that in such an embodiment, the device 5 can be pulled entirely, at least substantially, by the cable 4 while the hose or tube 7, 7A, 7B can hang relatively limply. As a result, the trawl 5 can compensate differences in depth of the water mass 1 and different speeds of the craft 3 in a simple manner without having to come free from the water bottom 2 or be pushed into it. However, a hose 7 can also be replaced by relatively rigid tubes known per se.

In Fig. 2, schematically in side view, with one of the supporting means 6 taken away, a device 5 according to the invention is shown, on a water bottom 2.. The device 5 is borne by two runners 6, as shown in top plan view in Fig. 3, on which runner a basket 8 is borne, manufactured from, for instance, wire, gauze or the like via which collected animals can be discharged via a tube or hose 7B. Near a side of the basket 8 forward in the direction of movement V, means 9 are provided for having animals 10 such as shellfish (Fig. 2) and fish (Fig. 4) disengage from the water bottom 2. In the embodiment shown in Figs. 2 and 3 the means 9 between the runners 6 comprise a series 12 of tines 14, also indicated as knives 14, arranged side-by-side and pivotable about an axis 13. Each tine 14 comprises a first part 15 forming a free end and a second part 16 including an angle α with a first part 15, which second part 16 connects the first part 15 to the axis 13 and a water supply hose 7A. The or each tine 14 is for instance of hollow design, while the free end remote from the second part 16 defines a nozzle 17 through which water, under pressure, supplied via the hose 7A, can be forced out of the tine 14. In Fig. 2, the passage of the water through the respective tine 14 is indicated with the arrows W.

Via a piston-cylinder assembly 18, each tine 14 is moveable, in particular pivotable about the axis 13, schematically indicated by the interrupted line 19, between a first position, in which the first part 15 extends approximately parallel to the water bottom 2, at least to a plane V defined by the undersides 20 of the runners 6, and a second position (shown in Fig. 2 for a second tine 14A) in which the respective tine 14A extends at least virtually completely above the water bottom 2 between the runners 6. Preferably, the water supply means such as the hose 7A and, for instance, a valve (not shown) arranged in or near the axis 13 are arranged such that water can only be forced out via the nozzle 17 when the respective tine 14 is in or near the first position, so that, with the tine in the second position, no water needs to be forced out.

Viewed in the direction of movement V, in front of the nozzle 17, above the runners 6, a series of detecting means 21 is included, in particular ultrasonic detecting means, a reflected sound of which is symbolically indicated in Fig. 2 by the arrows P. Naturally, also different detecting means can be used, for instance heat sensitive means, mechanical feelers which, as a result of the presence of animals, can observe changes present in the bottom, image recognition means and the like, arranged for recognizing the presence of animals in and/or on the bottom. Moreover, the detecting means can also be used for mapping the concentrations of animals, for instance for making population records. Here, no tines or startling means as described are used but the detecting means suffice, coupled to registering means with which the fish, crustacean and/or shellfish populations can be mapped so that developments can be recorded and the areas with for instance the most or, conversely, the least animals can be determined. The detecting means 21 are arranged such that therewith, animals 10 living on or in the water bottom 2 can be detected by specific reflection of the sound (see arrow P). Via a control device 22 such as a calculating unit, computer or the like, each detecting means 21 is coupled to a piston-cylinder assembly arranged immediately behind it and, hence, to a

tine 14. In Fig. 3, the connection is shown for one assembly of a detecting means 21, a calculating unit 22 and a piston cylinder assembly 18 with tine 14. It will be clear that the detecting means 21 in the series 23 are each coupled to a piston-cylinder assembly 18 and tine 14 in the series 12, in a comparable manner, while, if desired, one central calculating unit 22 can suffice. In Fig. 3, only one connection of the hose 7A with a tine 14 is shown. It will be clear that each tine 14 is connected to the or each hose 7A in a comparable manner.

A device 5 according to Figs. 2 and 3 can be used as follows.

The device 5 is coupled in the manner shown in Fig. 1 to the craft 3 and is dragged over the water bottom 2 in the direction V. As a result of the small forces occurring, the weight of the trawl 5 can be relatively small. With the aid of the piston-cylinder assemblies 18, the tines 14 are all brought in the second position, as shown for the tine 14A. With the aid of the detecting means 21, the bottom 2 just in front of the tines 14 is scanned for the presence of the desired animals 10. If an animal 10 is detected by a detecting means 21, via the calculating unit 22, the piston-cylinder assembly located immediately behind that and coupled therewith is controlled, so that the respective tine 14 is pushed from the second position into the bottom 2 to the first position, while via the nozzle 17, water is introduced into the bottom directly under the surface. The depth D over which the tine 14, at least nozzle 17, is pushed into the bottom is relatively small, for instance between virtually 0 and, for instance, 25 cm, more particularly between 0 and 7 cm. Mostly, an insertion depth of approximately 3 to 4 cm can suffice. Soil (sediment) of the water bottom 2 is slightly stirred up by the water jet W, exactly there where the animals such as cockles are present. The animals 10 then come to lie relatively free from the water bottom 2 and can be forced over the first part 15 of the tine 14 and along the contiguous second part 16 of the respective tine by advancing the device 5 in the direction V. Thus, the animals 10 are forced along the second part 16 from the sea bottom 2 and into the basket 8 where small parts such as sand, stone, small animals, small shells and the like can fall through

the bottom 23 of the basket 8, back onto the sea bottom 2, while the animals 10 can be discharged to the craft 3 via the respective hose or tube 7B. To that end, for instance water can be sucked or pressed through the hose 7B, propelling means known per se such as venturis and the like can be used. Naturally, the animals 10 can also be collected in the device 5 or be discharged to a different craft or the like. Such a method of collecting and discharging animals is known per se in practice.

When upon further advancement of the device 5 in the direction V no animal, at least too low a density, is observed by a respective detecting means 21, the respective tine 14 is brought back into the second position with the aid of the respective piston-cylinder assembly 18, so that no disturbance of the sea bottom 2 occurs there where no animals can be collected. With the aid of the calculating unit 22, the density of animals can simply be determined by the detecting means 21, while, for instance, a limit value for density can be determined for inserting or not inserting one or more tines 14 into the bottom 2. As a result, the disturbance of the water bottom 2 can be reduced to a minimum.

In the exemplary embodiments shown, each time, a series 12 of tines 14 is provided, as well as a series of detecting means 21. It will be clear that any desired number of tines 14 can be provided as well as any number of detecting means 21, while, for instance also several tines 14 can be controlled by one detecting means or one tine can be controlled on the basis of signals generated by several detecting means. Suitable control software and/or hardware can simply be built in into the calculating unit 22. This calculating unit 22 can be of electronic as well as mechanic design, or a combination thereof.

In a variant embodiment (not shown), the tines can be inserted into the bottom 2 in a different manner, virtually straight by carrying out a translation instead of a rotation, for instance a slideable tine. Such a translation can be effected with the same or comparable means. Also, a

combination of a rotating an translating movement can be opted for. Moreover, it is preferred that the axis 13 be height-adjustable relative to the runner 6, so that the insertion depth D can be set, for instance depending on the animals to be collected, the condition of the bottom and the like. Although the outflow direction W in Fig. 2 is shown to be approximately parallel to the bottom 2, at least the plane V, this can naturally also include a gentle angle therewith, for instance such that the direction W is directed slightly in the direction of the plane V. As a result, even less agitation of the sea bottom can be effected. As a consequence of the local water injection, relatively little water at relatively little pressure can suffice. Moreover, the nozzle 17 can be designed such that water is substantially and/or upwardly directed.

In Fig. 4, schematically, an alternative embodiment of a device 5 according to the invention is shown, in the form of a trawl net. In this embodiment, a hauling loop 24 is provided, coupled, on the one side, to the runners 6 and, on the other side, to a hauling cable 4. Between the runners 6, a pole 25 is provided on which a series of detecting means 21 and electric means 22, arranged alternately, is provided. In this embodiment, the detecting means 21 are arranged for transmitting, for instance in the direction of movement V, sounds signals P, directed forwards and somewhat in the direction of the bottom 2. When the sound signal P hits an animal 10, such as a flatfish on or slightly in the bottom 2, then, an adjacent electric means 22 is controlled for building up an electric and/or magnetic field, in a manner known per se. To this end, for instance an electric coil or the like can be controlled. The electric and/or magnetic field T, schematically indicated in Fig. 4 around an electric means 22 is sensed by the animal 10 and experienced as less agreeable. This results in the animal 10 swimming somewhat upwards, away from the bottom 2. Behind the runners 6, a net 26 is tautened which is held at a limited distance from the bottom with a forward open front side 27, turned in the direction of the pole 25. The animal 10, chased from the bottom 2 in the earlier described manner, will swim over or under the beam 5, at least the

beam 25 will be moved along the animal 10, so that the animal 10 will end up in the net 26. Naturally, instead of a net, also a different capturing means can be used, such as a cage.

Since the detecting means 21 mentioned are used for detecting animals 10, in particular individually, simple electric means 22 and relatively light electric and/or magnetic fields T suffice. As a result, with minimum energy, in a particularly economical manner, the collection of animals 10 becomes possible. It will be clear that the electric means as shown in Fig. 4 can also be used with a device according to Figs. 2 and 3, while the animals 10, for instance with a device according to Fig. 4, can also be chased in a different manner, for instance byproviding, instead of electric means 22, means for generating specific air or water jets aimed at the animal 10, so that it swims upwards away from the bottom 2. With a device according to Fig. 4 too, tines 14 can be used for guiding animals into the net 26.

With a method and device according to the invention, with the aid of the detecting means 21, concentrations of animals 10 can be tracked down, at least detected, so that specific agitations of the bottom can be reduced to a minimum, while a device 5 according to the invention can be of particularly light design, notably so in that little buoyant force is applied on the device during moving. As the device 5 can be of relatively light design, it can be dragged with relatively light crafts, i.e. with relatively little power, so that as a result of the drives of the craft, relatively little agitation will occur in the water. Moreover, this requires relatively little energy and in a relatively short period of time, a high efficiency can be obtained as collection only takes place there where the animals are present in a desired concentration. Naturally, also with relatively expensive animals, collecting a few animals could be economically worthwhile. As a result of the limited agitation of the bottom, moreover, the quality of the fished animals can be improved, as they will take up relatively little sand, sediment or other contaminations.

Instead of or in addition to electric means, drivable by the detection means, naturally, also different means can be used, for instance mechanical means such as short chains moveable in a controlled manner, alarms, vibrating or jolting elements and the like, acoustic means such as sound sources, or means for generating fluid jets, to be directed at the animals.

With a device and method according to the invention, it is preferred that detection means and/or the control means be arranged for speed measurement for the purpose of determining the location of the animals relative to the tines, so that a tine can be inserted into the bottom still more accurately, just before arriving at the respective animal. Also, the detecting means can be arranged such that the depth at which the animals are present can be determined.

In a variant shown in Fig. 5, a tine 14 is linearly moveable with the aid of the piston-cylinder assembly 18. With it, the knife is moved into and from the bottom in a translating manner.

In Fig. 6, a variant is shown in which suction means 27 are disposed, near the tines, at least behind the detecting means 21, with which the animals can be sucked from the bottom and be discharged via the hose 7. The suction means 27 are operated by the detecting means, at least the control unit 22, so that suction only takes place when a desired amount of animals has been detected. Thus, the bottom agitation can be still further limited. When used in a sufficiently loose bottom or with sufficient suction power and/or at a limited depth, optionally, the tines can be omitted and introducing a fluid such as water, gas or slurry into the bottom can be dispensed with.

The invention is not limited in any manner to the exemplary embodiments represented in the description and the drawing. Many variations thereon are possible within the framework of the invention as outlined by the claims.

For instance, a collecting device 5 according to the invention can be borne and/or advanced in a different manner, for instance by series of wheels

or caterpillar tracks, by several runners and the like. The tines may be moved in a different manner, for instance electrically, pneumatically or hydraulically while, for instance, rotation of the axis 13 can ensure the desired movement. Water can be injected into the bottom in a different manner, for instance by-means arranged separately from the tines 14, while also different fluids can be used, for instance air. Different numbers of tines, detection means and electrical means can be used, while also different driving means can be provided. Water for injection can also be supplied in a different manner, for instance by pumping means placed directly on the device 5. Different detecting means can be used, in addition to or instead of the sound detecting means, such as, for instance, infrared detecting means, means for detecting gas bubbles, movement, sound or the like, generated by the animals, means for determining electric fields and such generated by the animals. These and many comparable variations are understood to fall within the framework of the invention as outlined by the claims.